10978

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INSTRUCTION MANUAL

FOR

PRECISION AC-DC VOLTMETER

MODELS AC-200B/BR
AC-150B/BR
AC-110B/BR
AC-100B/BR

ELECTRONIC INSTRUMENTATION FOR INDUSTRY

CALIBRATION STANDARDS CORPORATION *a subsidiary of* ROYAL INDUSTRIES, INC.

CALIBRATION STANDARDS CORPORATION

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MODELS AC-200B/BR
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AC-100B/BR

SERIAL 2259

CALIBRATION STANDARDS CORPORATION

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IMPORTANT

FOR OPTIMUM RESULTS, PLEASE READ THE INSTRUCTION MANUAL CAREFULLY.

This instrument you have purchased represents a major advance in the field of transistorized precision test equipment.

Since this instrument incorporates the latest engineering techniques and design, it is imperative that you become familiar with the proper operating procedure.

Meter zeroing adjustment is performed at the factory. Normally no further adjustment is required. Should adjustment be necessary, the meter may be zeroed by the mechanical adjustment screw on the meter itself while the instrument is operating.

OPERATING INSTRUCTIONS

DC MODE

1. The line cord should be plugged into a 117-volt 60-cycle power source. (220-volt if indicated).
2. Turn the null selector to TVM position and power switch on. Let the instrument warm up for approximately 10 minutes.
3. Check mechanical zero of meter. If necessary, adjust to zero by means of the screw in the center of the meter case.
4. Turn the range selector knob to the desired range. Connect the voltage to be measured to the terminal posts. Either positive or negative may be grounded to the common terminal. When operating with the polarity switch in the positive mode, the negative terminal is generally grounded to the case or left floating and in the negative mode, the reverse.
5. The voltage now indicated on the meter is accurate within 4%. If the meter needle swings to the left, turn the polarity switch to the NEG position.
6. Position first two readout dials to the approximate TVM voltage reading. Advance the null selector knob to the 1-volt position. Continue to adjust the readout while increasing the null sensitivity. You are now zeroing in on null.
7. When, by the procedure above, the null selector is at full sensitivity (1 mv) and the meter reading zero, the voltage read from the dials is accurate to better than the rated accuracy of the instrument. Because the sensitivity of your instrument in the 1 mv null position is higher than the stability of many sources, you may not get a reading of zero if the voltage you are measuring is not constant and is fluctuating.

OPERATING INSTRUCTIONS (Continued)

READING EXCURSIONS ABOUT A NOMINAL VOLTAGE

8. To read excursions of voltage about a nominal value, set the readout dials to the nominal value. Excursions may be observed directly on the meter on any of the four null ranges. A right hand deflection of the meter indicates the voltage has increased above the nominal value by the amount indicated on the meter. For voltages read on the 10-volt range and below, use null sensitivity selector as marked. On the 100-volt ranges, the null sensitivity selector value must be multiplied by a factor of 10. On the 1000-volt range the null sensitivity selector value must be multiplied by a factor of 100.

DIRECT MEASUREMENTS OF 10 VOLTS AND ABOVE

9. With the range selector in the 10-volt position, use full scale values as marked on the meter. When range selector is in the 100-volt position, multiply the meter reading by 10. On the 1000-volt range, multiply the reading by 100.

VARIATIONS IN NULL DETECTOR SENSITIVITY

10. Due to the circuit design on the 100-volt range, the null detector will have reduced sensitivity on the 1 mv and 10 mv positions. This is due to a high internal source impedance of the high voltage input divider. The sensitivity is about 50% less in the 1 mv null position and about 15% less on the 10 mv position. Only a very slight loss of sensitivity is noticed on the other null ranges. When the range selector is in the 1000-volt position, a 10% loss of sensitivity will be noticed in the 1 mv position.

OPERATING INSTRUCTIONS (Continued)

The other null ranges will have only a very slight loss of sensitivity.

MEASUREMENTS BELOW 1 VOLT IN DIFFERENTIAL MODE

11. When making measurements below 1 volt, turn Range Selector switch to the 1-volt position. Set null selector to the 1 mv position. Set all readout dials to zero and short positive and negative input terminals together.

12. Now set the mechanical meter adjustment to zero. This will cancel out error due to zero offset between the 1 millivolt range and the VTVM range. Remove short across terminals and proceed with the reading of voltage per paragraphs 4, 5, 6, and 7.

"POS" AND "NEG" POLARITY

13. This instrument is capable of measuring both positive and negative voltages without reversing the input connections, by setting the polarity switch in the correct position.

Under some conditions the reading in the "NEG" position may differ from the "POS" position. This difference is very small in comparison to the rated accuracy of the instrument. Since the instrument is calibrated in the "POS" position, the best accuracy will result when the polarity switch is in this position.

OPERATING INSTRUCTIONS (Continued)

RECORDER OUTPUT

14. Two sets of output terminals are located on the rear of the voltmeter. One set is the recorder output and the other is the Kelvin-Varley output. The output voltage of the recorder output terminals is ±25 mv for a full scale deflection. The output impedance is approximately 200Ω. Any recorder may be used so long as the leakage resistance to the line or ground is better than 10,000 megohms.

When using high speed recorders, it may be necessary to install a filter between the output terminals of the voltmeter and the input of the recorder. The output signal of the voltmeter will have the demodulated chopper signal and must be filtered out. Generally a three-stage RC filter using 33K resistors and 1 mfd capacitors will be sufficient.

KELVIN-VARLEY OUTPUT

15. The second set of terminals provide an output from the Kelvin-Varley Divider. The maximum output is 10 vdc when the instrument range selector is in the 10-volt position. A chart showing the output impedance of the KVD is located in the back of this manual.

OPERATING INSTRUCTIONS (Continued)

AC MODE

16. Follow instructions under DC MODE, paragraphs 1, 2, and 3.

17. For best results, connect the ground terminal to the negative terminal. However, in most applications the input may be left floating.

18. Polarity switch must be set to AC.

19. Turn the range selector knob to the desired range. Connect the voltage to be measured to the input terminal posts. The voltage now indicated on the meter is accurate within 4%.

20. Position the first two readout dials to the approximate TVM voltage reading. Advance the null selector knob to the 1-volt position. Continue to adjust the readout while increasing the null sensitivity. You are now zeroing in on the null.

21. When, by the procedure above, the null selector is at full sensitivity and the meter reading zero, the voltage read from the dials is accurate to better than the rated accuracy of the instrument. Because the sensitivity of your instrument in its most sensitive position is higher than the stability of many sources, you may not get a reading of zero if the voltage you are measuring is not constant and is fluctuating.

OPERATING INSTRUCTIONS (Continued)

READING EXCURSIONS ABOUT A NOMINAL VOLTAGE

22. To read excursions of voltage about a nominal value, set the readout dials to the nominal value. Excursions may be observed directly on the meter on any of the four null ranges. A right hand deflection of the meter indicates the voltage has increased above the nominal value by the amount indicated on the meter. For voltages read on the 10-volt range, use null sensitivity selector as marked. On the 100-volt ranges, the null sensitivity selector value must be multiplied by a factor of 10. On the 1000-volt range the null sensitivity selector value must be multiplied by a factor of 100.

DIRECT MEASUREMENTS OF 10 VOLTS AND ABOVE

23. With the range selector in the 10-volt position, use full scale values as marked on the meter. When range selector is in the 100-volt position, multiply the meter reading by 10. On the 1000-volt range, multiply the reading by 100.

VARIATIONS IN NULL DETECTOR SENSITIVITY

24. Due to the circuit design on the 100-volt range, the null detector will have reduced sensitivity on the 1 mv and 10 mv positions. This is due to a high internal source impedance of the high voltage input divider. The sensitivity is about 50% less in the 1 mv null position and about 15% less on the 10 mv position. Only a very slight loss of sensitivity is noticed on the other null ranges. When the range selector is in the 1000-volt position, a 10% loss of sensitivity will be noticed in the 1 mv position.

CIRCUIT DESCRIPTION

DC SECTION

This Calibration Standards Corporation Voltmeter is designed for long, trouble-free life. There are no batteries or components that would normally need replacing.

This dependable voltmeter operates on the principle of comparing an unknown voltage with an adjustable known voltage. A sensitive null detector is used to provide a means of sensing when the known and unknown voltages are equal.

The DC section of the voltmeter is composed of three basic elements:

(1) An ultra stable reference supply.

(2) An accurate Kelvin-Varley divider.

(3) A sensitive null detector.

CIRCUIT DESCRIPTION (Continued)

1. The heart of the voltmeter is the ultra stable reference voltage supply. This supply is a dual regulated transistor supply powering a compensated Zener reference string. The transistors and Zener diodes are silicon, and therefore will withstand high temperatures without impairing the life of the assembly. Following is a performance chart of the references.

Specification	AC-200B/BR	AC-150B/BR	AC-110B/BR	AC-100B/BR
Regulation for 10% line change, 15°C to 40°C	±0.001%	±0.001%	±0.002%	±0.005%
Temperature coefficient	±2 ppm/°C	±3 ppm/°C	±5 ppm/°C	±5 ppm/°C
Long-term stability of Zener - typical	±10 ppm	±10 ppm	±20 ppm	±20 ppm
- maximum	±20 ppm	±20 ppm	±40 ppm	±50 ppm

The reference voltage supply is constructed as a printed circuit assembly. Spares and replacements are available from the factory. When ordering, be sure to indicate the serial number of the instrument.

CIRCUIT DESCRIPTION (Continued)

2. The second basic element is the very accurate Kelvin-Varley Divider. All readout decks except the last have 11 carefully matched precision wire-wound resistors. The chart below shows the maximum Kelvin-Varley divider linearity and yearly stability.

Model	Linearity	Maximum Stability	Typical Stability
AC-200B/BR	±20 ppm	±5 ppm	±1-2 ppm
AC-150B/BR	±25 ppm	±5 ppm	±1-2 ppm
AC-110B/BR	±75 ppm	±20 ppm	±3-5 ppm
AC-100B/BR	±100 ppm	±20 ppm	±3-5 ppm

Since the divider resistors operate at very los power ratings, the long-term stability of the divider is that of the long-term ratio stability at shelf-life. The resistors are preaged and tested for best stability before installation in the instrument.

The resistors used in the first deck of the AC-200B/BR and AC-150B/BR Kelvin-Varley Divider are the most stable type of resistor possible to manufacture. They are wound with very little strain and are sealed in silicon oil. Resistors of this type are also utilized in the range divider network.

The range selector precedes the Kelvin-Varley Divider. Each range has a fine adjustment potentiometer for calibration. Each is calibrated separately.

CIRCUIT DESCRIPTION (Continued)

3. The third element is a very sensitive and stable calibrated null detector. This null detector is used to indicate the difference between an unknown external voltage and a known internal voltage. At maximum sensitivity the null detector has a full-scale deflection of 1 mv. This provides ample sensitivity for accurate low-level voltage measurements. The TVM accuracy is ±4% of full scale over a temperature range of 10°C to 40°C. The instrument is usable to 50°C but some derating should be considered.

The null detector is capable of a long, trouble-free life except for the occasional replacement of the chopper. These are highly reliable, however, do occasionally need replacement. Choppers are available from stock at the factory. The occasional calibration of the null detector may be made by adjusting the gain-adjustment potentiometer, R32, located in the amplifier printed circuit board. An electrical zero control, R31, is also located on this board.

The null detector is capable of large overloads without damage. On the 1 mv range a safe overload would be 50 volts short-term and 10 volts long-term. On the 10 mv, 100 mv, and 1V positions, a safe overload of 500 volts is possible.

CIRCUIT DESCRIPTION (Continued)

In the VTVM position ranges, safe overloads are as follows.

1-volt range:	70 volts
10-volt range:	250 volts
100-volt range:	700 volts
1000-volt range:	1500 volts

CALIBRATION

DC

A suggested setup for calibrating the instrument is included in this manual.

A. CALIBRATION OF THE DIFFERENTIAL SECTION

The "RANGE SELECTOR" - "10V" range is calibrated first. On this range the instrument has an infinite input resistance at null.

1. Check mechanical zero of meter. If necessary, adjust to zero by means of the screw in the center of the meter case.
2. Next, turn "NULL SELECTOR" to the TVM position and power switch on. Check electrical zero of meter. If necessary, adjust to zero by means of R31.
3. Apply a known 10-volt calibration voltage across the "POS" and "NEG" input terminals. The instrument meter should read full scale. Turn "READOUT" dials to read (9). (9) (9) (9) (10) and turn "NULL SELECTOR" switch to the "1 MV" position. Bring meter to zero by adjusting the appropriate calibration trim potentiometer. (See calibration board component layout.)
4. Repeat the basic procedure for calibration of the "1V" range using a known 1 volt. Repeat the basic procedure for calibration of the "00 mv" range using a known 100 mv source. (Omit where not applicable.)
5. The "RANGE SELECTOR" - "100V" and "1000V" ranges are calibrated next. On these ranges the instrument has a 2 megohm input resistance.
6. Turn the "RANGE SELECTOR" switch to the "100V" position and apply a known 100-volt calibration voltage at meter input. Continue basic calibration procedure outlined in paragraph 3.

NOTE: Multiply "NULL SELECTOR" ranges by 10.

CALIBRATION (Continued)

7. Turn the "RANGE SELECTOR" switch to the "1000V" position. Apply a known 500 volts with the "READOUT" dials turned to (5) (0) (0) (0) (0) (0). Bring meter to zero by adjusting the appropriate trim potentiometer.

B. CALIBRATION OF THE TVM RANGES

Calibrate the TVM Ranges by setting the "RANGE SELECTOR" switch to the "10V" position and apply a known 10-volt calibration voltage. Adjust potentiometer R32 for full-scale deflection. It is not necessary to calibrate the remaining TVM ranges.

CALIBRATION

AC

After the DC section of the instrument has been calibrated, the AC section may be calibrated. A very stable AC source must be used along with an AC-DC transfer standard accurate to .02% or better. The Elin Model VC-555 is recommended for the stable AC source.

Calibrate the 10-volt range first. Set the range switch to 10 volts with the readout at 5.0000 volts. Apply an exact 5 volts at 400 cps. Adjust amplifier gain control (TR1), using the 10 mv null range sensitivity. Now change the frequency of the AC source to 10,000 cps and adjust the trim capacitor (C117) located at the right side of the converter module, 420-071. Turn the instrument range selector to the 100-volt range and set the readout at 50.000 volts. Apply 50 volts 400 cps to the meter and adjust the 100-volt calibration trimpot (R77) located on the divider board. Change the frequency to 10,000 cps and adjust the 100-volt trim capacitor (C35). Change the frequency to 5,000 cps and adjust trimpot (R75). Recheck at 10,000 cps and readjust C35 if necessary. Turn the instrument range selector to the 1000-volt range and set the readout to 500.00 volts. Apply 500 volts 400 cps to the meter and adjust the 1000-volt calibration trimpot (R78). Change the frequency to 10,000 cps and adjust the 1000-volt trim capacitor (C36). Change the frequency to 5,000 cps and adjust trimpot (R76). Recheck at 10,000 cps and readjust C36 if necessary.

WARRANTY

The CALIBRATION STANDARDS CORPORATION warrants each instrument to be free from defects in material and workmanship. The instrument must be returned to the factory with shipping prepaid and a complete report of the difficulty. This warranty is good for one year from the shipping date.

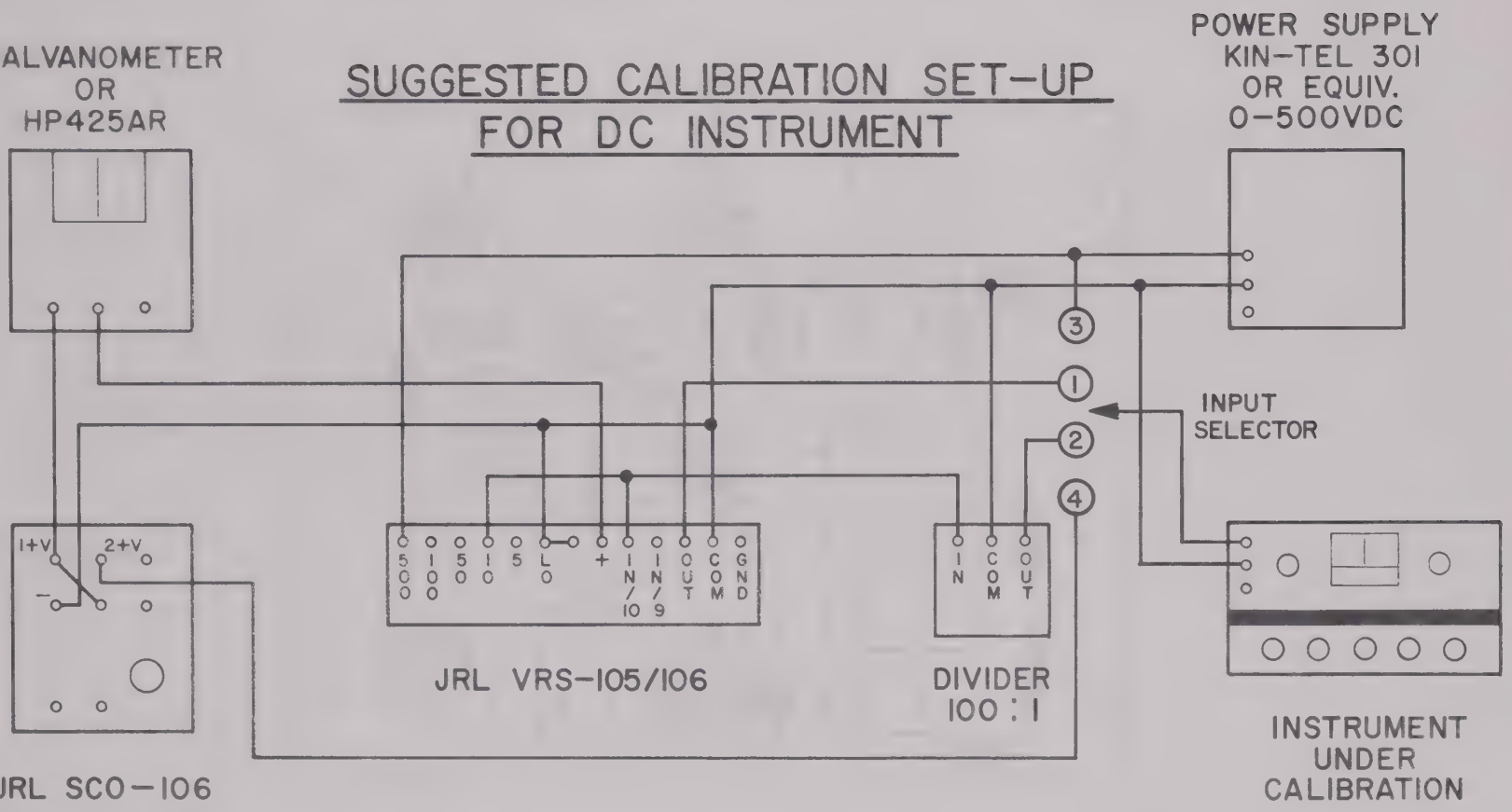
SHIPPING DAMAGE

If there is any damage to the instrument upon receipt, report this to the transportation claim agent immediately.

JULIE RESEARCH LABS MODEL SCO-106 CELL ACCURACY 1-2PPM.

JULIE RESEARCH LABS MODEL VRS-105/106 ACCURACY 10PPM CALIBRATOR-10PPM RATIO.

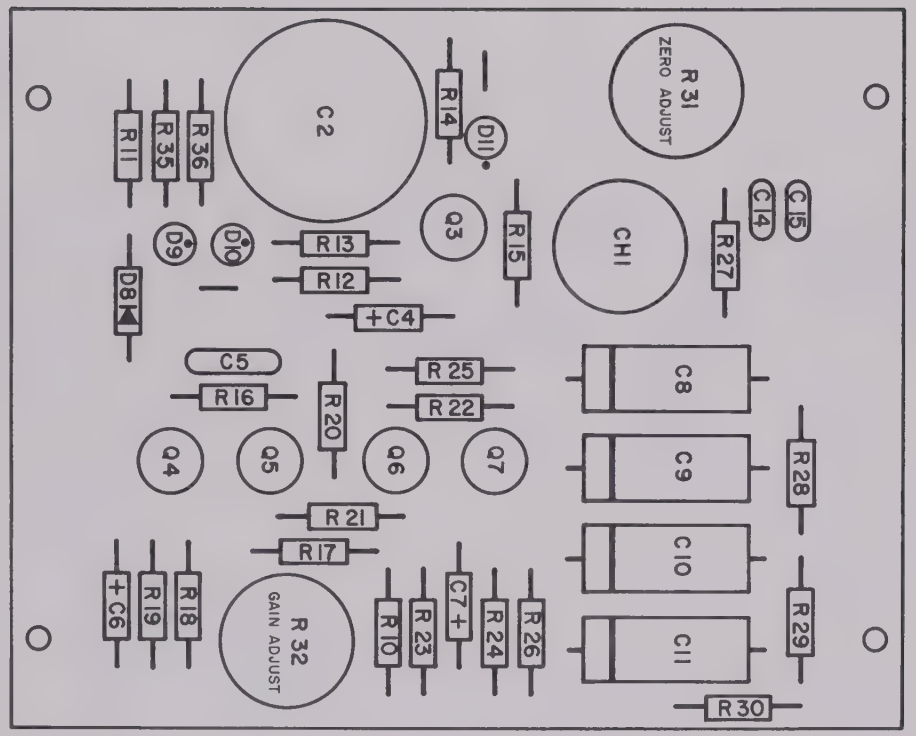
SUGGESTED CALIBRATION SET-UP FOR DC INSTRUMENT



3. CARE SHOULD BE TAKEN WHEN OPERATING INSTRUMENT IN NEGATIVE MODE AS SHORTS MAY DAMAGE OR SHORTEN LIFE OF TEST EQUIPMENT.
2. FOR CALIBRATION OF 100MV RANGE DIVIDER SHOULD BE OF AT LEAST 20PPM ACCURACY.
1. FOR CALIBRATION OF 1.0V RANGE SET RATIO ON DIVIDER (JRL) TO 1.

NOTES:

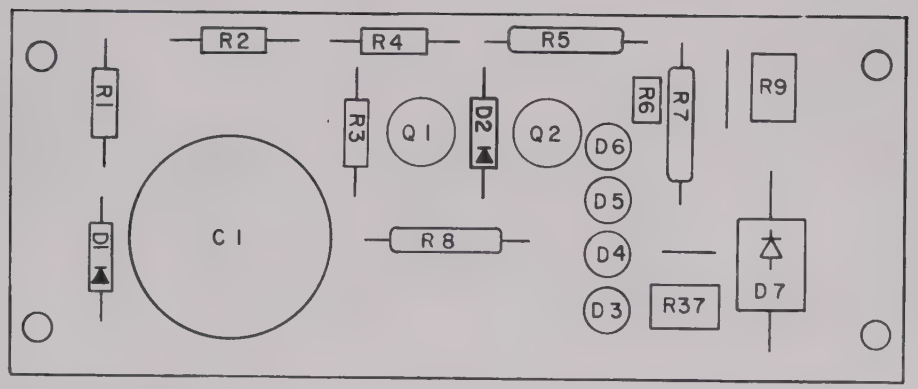
RANGE	INPUT SELECT.	POWER SUPPLY	VRS RATIO	VRS 105
1000V	3	500V	N. U.	500V
100V	3	100V	N. U.	100V
10V	4	10V	N. U.	10V
1.0V	1	10V	10 : 1	10V
100MV	2	10V	N. U.	10V



COMPONENT LOCATION AMPLIFIER

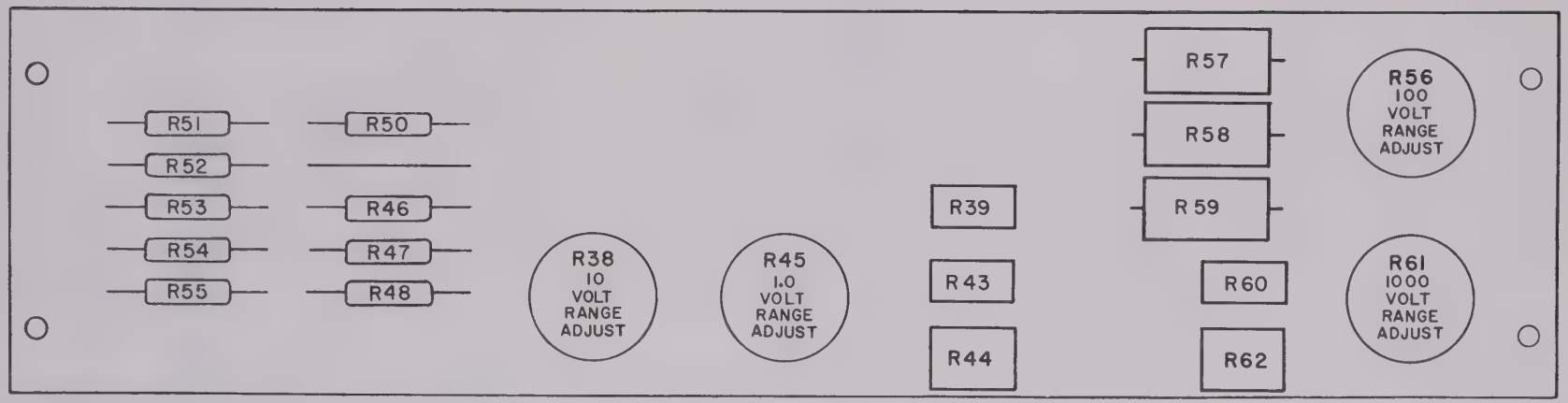
400-106

(REVISION A)



COMPONENT LOCATION REFERENCE

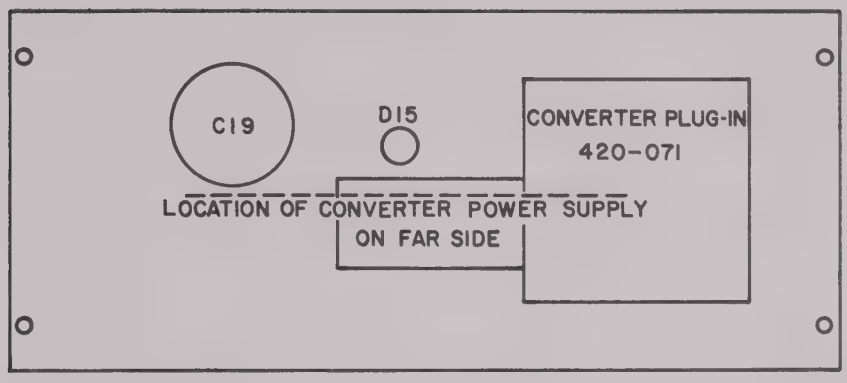
400-107



COMPONENT LOCATION CALIBRATION

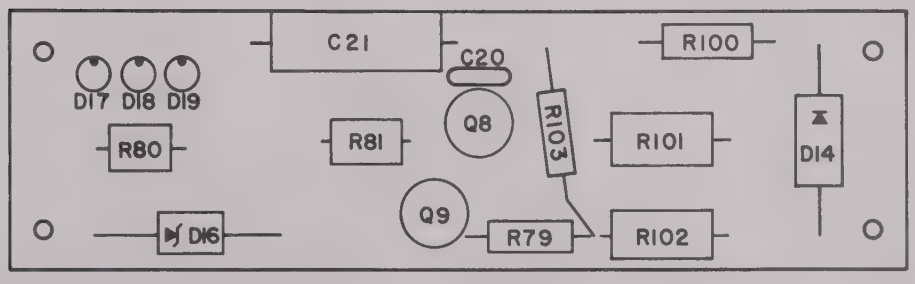
400—108

(REVISION A)



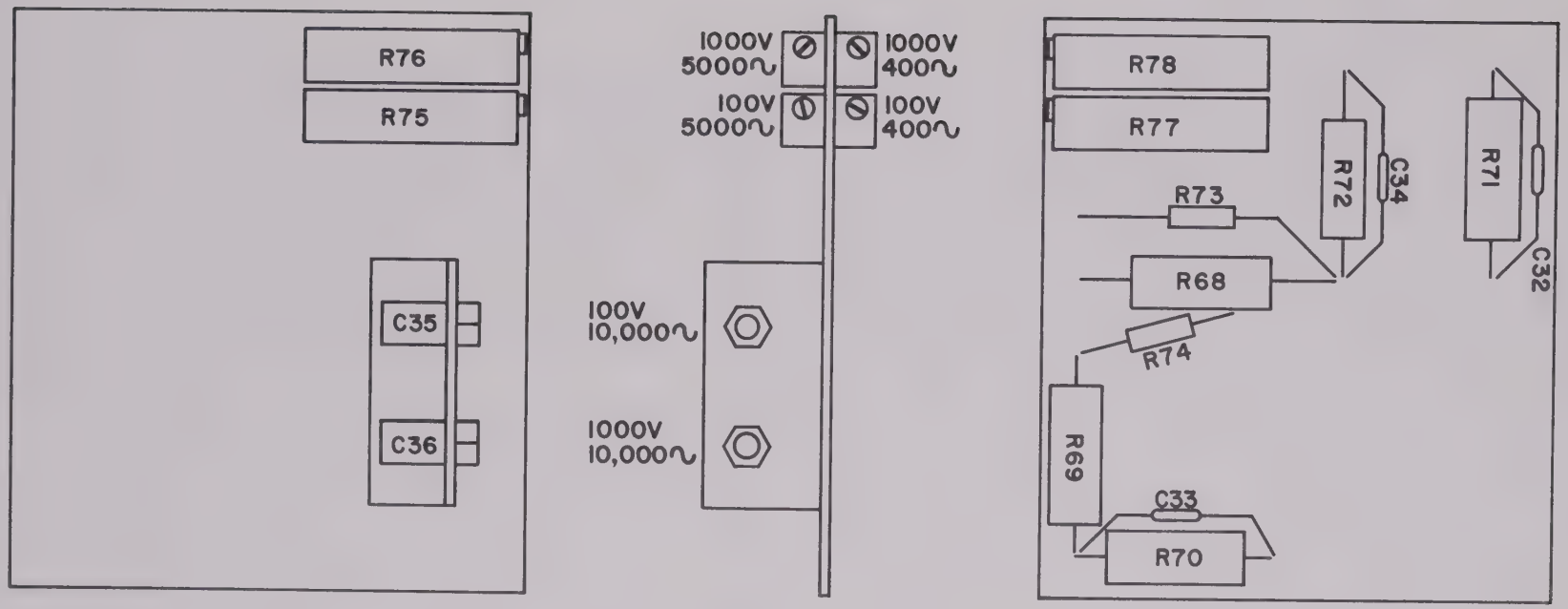
COMPONENT LOCATION CONVERTER

400-146



COMPONENT LOCATION CONVERTER POWER SUPPLY

400-153



COMPONENT LOCATION AC DIVIDER BOARD

PART OF 400-148

REPLACEMENT PARTS LIST

Reference or Quantity	Description	Stock Number
Reference Supply Sub-Assembly, 400-107 & 400-124		
R1, R2	Resistor, FC, 47Ω, 10%, 1/2W	201-470
R3	Resistor, FC, 3.3KΩ, 10%, 1/2W	201-332
R4	Resistor, FC, 2.2KΩ, 10%, 1/2W	201-222
R5	Resistor, DC, 700Ω, 1%, 1/2W	205-032
R6	Resistor, NTC, 400Ω	209-001
R7	Resistor, DC, 300Ω, 1%, 1/2W	205-021
R8	Resistor, DC, 6KΩ, 1%, 1/2W	205-042
R9	Resistor, Wire Wound	*
R37	Resistor, Wire Wound	*
C1A, C1B	Capacitor, Dual Electrolytic, 100-100 mfd, 50 vdc	222-013
D1	Diode	216-025
D2	Zener Diode	216-008
D3, D4, D5, D6	Zener Diode	216-004C
D7	Zener Diode, CSC 12-1	*
Q1	Transistor, PNP Silicon	215-036A
Q2	Transistor, NPN Silicon	215-015A
2	Pad, Transistor	218-004

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
Amplifier Sub-Assembly, 400-106		
R10, R11	Resistor, FC, 47Ω, 10%, 1/2W	201-470
R12	Resistor, FC, 1KΩ, 10%, 1/2W	201-102
R13	Resistor, FC, 33Ω, 10%, 1/2W	201-330
R14, R18	Resistor, FC, 2.2KΩ, 10%, 1/2W	201-222
R15	Resistor, FC, 150Ω, 10%, 1/2W	201-151
R16, R20	Resistor, FC, 10KΩ, 10%, 1/2W	201-103
R17, R21	Resistor, FC, 47KΩ, 10%, 1/2W	201-473
R19	Resistor, FC, 6.8KΩ, 10%, 1/2W	201-682
R22	Resistor, FC, 680KΩ, 10%, 1/2W	201-684
R23, R27, R28, R29, R30	Resistor, FC, 33KΩ, 10%, 1/2W	201-333
R24	Resistor, FC, 100KΩ, 10%, 1/2W	201-104
R25	Resistor, FC, 1.5MΩ, 10%, 1/2W	201-155
R26	Resistor, FC, 1.0MΩ, 10%, 1/2W	201-105
R35, R36	Resistor, FC, 680Ω, 10%, 1/2W	201-681
R31	Resistor, Variable, 1KΩ	210-010
R32	Resistor, Variable, 200Ω	210-009
C2A, C2B, C2C	Capacitor, Triple Electrolytic, 100-100-250 mfd, 50-50 vdc	222-014
C4, C6	Capacitor, Tantalum, 60 mfd, 6 vdc	223-008
C5	Capacitor, Disc, .05 mfd, 75 vdc	220-002
C7	Capacitor, Tantalum, 8.2 mfd, 20 vdc	223-009

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
Amplifier Sub-Assembly, 400-106 (continued)		
C8, C9, C10, C11	Capacitor, Mylar, 1 mfd, 100 vdc	220-033
D8	Diode	216-025
D9, D10	Zener Diode	216-004C
D11	Zener Diode	216-004A
Q3, Q4, Q5, Q6, Q7	Transistor, NPN Silicon	215-015A
CH1	Chopper	230-004
5	Pad, Transistor	218-004
1	Socket, 7-pin	260-011
C14, C15	Capacitor, 3.3 mmf	220-007

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
Calibration Board Sub-Assembly, 400-143		
R40	Resistor, WW, 24.650KΩ, .05%, 1/3W	203-002
R41	Resistor, WW, 252.5Ω, .05%, 1/3W	203-003
R43	Resistor, WW, 22.400KΩ, .05%, 1/3W	203-004
R44	Resistor, WW, 2.775KΩ, .05%, 1/3W	203-005
R46	Resistor, DC, 9KΩ, 1%, 1/2W	205-001
R47	Resistor, DC, 900Ω, 1%, 1/2W	205-039
R48	Resistor, DC, 100Ω, 1%, 1/2W	205-036
R49	Resistor, DC, 90KΩ, 1%, 1/2W	205-004
R50, R54	Resistor, DC, 900KΩ, 1%, 1/2W	205-002
R66	Resistor, DC, 990KΩ, 1%, 1/2W	205-028
R51, R55, R56	Resistor, DC, 9MΩ, 1%, 1/2W	205-005
R52	Resistor, DC, 11KΩ, 1%, 1/2W	205-008
R67	Resistor, DC, 10KΩ, 1%, 1/2W	205-007
R53	Resistor, DC, 300KΩ, 1%, 1/2W	205-009
R57, R58, R59	Resistor, WW, 600KΩ, .05%, 1/3W	203-001
R60	Resistor, WW, 179.750KΩ, .1%, 1/3W	203-062
R62	Resistor, WW, 19.950KΩ, .05%, 1/3W	203-006
R56	Resistor, Variable, 500Ω	210-012
R38, R42, R45	Resistor, Variable, 200Ω	210-009
R61	Resistor, Variable, 100Ω	210-011

REPLACEMENT PARTS LIST (Continued)

Reference	Description	Stock Number
AC Divider & Range Switch Sub-Assembly, 400-147		
S2	Switch, Rotary	240-057
R68, R69, R70	Resistor, MF, 1MΩ, 1/2W, 1%	206-002
R71	Resistor, MF, 20KΩ, 1/2W, 1%	206-003
R72	Resistor, MF, 121KΩ, 1/2W, 1%	206-005
R73	Resistor, FC, 220KΩ, 1/2W, 10%	201-224
R74	Resistor, FC, 68KΩ, 1/2W, 10%	201-683
R75, R76	Resistor, variable, 500K	210-013
R77	Resistor, variable, 5K	210-007
R78	Resistor, variable, 1K	210-006
C32	Capacitor, disc, 560 mmf	220-003
C33	Capacitor, disc, 3.3 mmf	220-007
C34	Capacitor, disc, 15 mmf	220-015
C35, C36	Capacitor, variable, .8-4.5 mmf	224-001

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
Kelvin-Varley Divider, 2,500Ω, Sub-Assembly, 400-116**		
S4	Switch, Rotary	240-046
R212-R222	Resistor, WW, 2.5KΩ, .05%, 1/3W	203-132
Kelvin-Varley Divider, 500Ω, Sub-Assembly, 400-117**		
S5	Switch, Rotary	240-046
R223-R233	Resistor, WW, 500Ω, .05%, 1/3W	203-102
Kelvin-Varley Divider, 100Ω, Sub-Assembly, 400-110		
S6	Switch, Rotary	240-046
R234-R244	Resistor, WW, 100Ω, .1%	203-106
Kelvin-Varley Divider, 20Ω, Sub-Assembly, 400-111		
S7	Switch, Rotary	240-046
R245-R255	Resistor, WW, 20Ω, .5%	203-107
R64	Resistor, Variable, WW, 50Ω	210-016
R63	Resistor, FC, 10%, 1/2W	***

REPLACEMENT PARTS LIST

Reference or Quantity	Description	Stock Number
Converter Sub-Assembly, 420-010		
Q1, Q2, Q3, Q5	Transistor	215-015A
Q4	Transistor	215-018
R1	Resistor, MF, 1MΩ, 1%	206-002
R2	Resistor, MF, 20K, 1%	206-003
R3	Resistor, MF, 200K, 1%	206-004
R6, R4	Resistor, DC, 10K, 1%	205-007
R5	Resistor, MF, 4K, 1%	206-006
R11, R16	Resistor, FC, 10K, 1/2W, 10%	201-103
R7	Resistor, FC, 680Ω, 1/2W, 10%	201-681
R8	Resistor, FC, 330K, 1/2W, 10%	201-334
R9	Resistor, FC, 47K, 1/2W, 10%	201-473
R10, R15	Resistor, FC, 2.2K, 1/2W, 10%	201-222
R12	Resistor, FC, 150K, 1/2W, 10%	201-154
R13	Resistor, FC, 1.5K, 1/2W, 10%	201-152
R14, R17, R18	Resistor, FC, 33K, 1/2W, 10%	201-333
R19	Resistor, FC, 270K, 1/2W, 10%	201-274
R20, R22, R23	Resistor, FC, 22K, 1/2W, 10%	201-223
R21	Resistor, FC, 3.3K, 1/2W, 10%	201-332
R24, R25	Resistor, DC, 50K, 1%	205-011
R26, R27	Resistor, MF, 24.9K, 1%	206-007

REPLACEMENT PARTS LIST

Reference or Quantity	Description	Stock Number
Converter Sub-Assembly, 420-010 (Continued)		
R28	Resistor, MF, 909Ω, 1%	206-011
R29	Resistor, DC, 12K, 1/2W, 1%	205-019
TR1	Resistor, Variable, 10Ω	210-001
C2, C5, C10, C9	Capacitor, Tantalum, 15 mf, 30V	223-003
C3, C6	Capacitor, Tantalum, 8 mf, 50V	223-002
C8, C12	Capacitor, Tantalum, 60 mf, 6V	223-009
C4	Capacitor, Disc, .001 mf, 75V	220-008
C7	Capacitor, Disc, 330 mmf, 75V	220-006
C11	Capacitor, Mylar, 5 mf, 200V	220-035
C13, C14, C15	Capacitor, Mylar, 1 mf, 100V	220-033
C16A	Capacitor, Disc, 100 mmf	220-009
C16B	Capacitor, Disc, 39 mmf	220-005
D1, D2	Diode	216-015
D3	Zener Diode	216-011
C117	Capacitor, Variable, .8-4.5 mmf	224-001

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
Converter Power Supply, 400-153		
D14	Diode	216-025
D16	Zener diode	216-016
D17, D18, D19	Zener diode	216-004A
Q8	Transistor, PNP, Silicon	215-036A
Q9	Transistor, NPN, Silicon	215-015C
C20	Capacitor, Disc, 100 mmf	220-009
C21	Capacitor, Mylar, 1 mmf, 100v	220-033
R101, R102	Resistor, FC, 470Ω, 10%, 1W	2011471
R78	Resistor, FC, 1.5KΩ, 10%, 1/2W	201-152
R79	Resistor, FC, 2.2KΩ, 10%, 1/2W	201-222
R100	Resistor, FC, 33Ω, 10%, 1/2W	201-330
R80	Resistor, WW, 30KΩ, 1%, .25W	203-204
R81	Resistor, FC, 12KΩ, 1%, .25W .	203-203

D15	Zener diode	216-014
C19	Capacitor, Electrolytic	222-007

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
T1	Power Transformer, 115 vac, 50-60 cps Power Transformer, 230 vac, 50-60 cps	235-015 235-017
C12	Capacitor, Disc, .02 mfd, 1K vdc	220-001
F1	Fuse, 3 AG, 1/4 amp	261-005
1	Fuse Holder	261-002
1	Line Cord	264-001
1	Strain Relief	283-001
5	KVD Switch Readout Dial	400-112
1	KVD Pot Readout Dial	400-113
S1	Switch, Rotary, Null	240-044
S8	Switch, Toggle, SPST	240-047
S9	Switch, Toggle, DPDT	240-026
M1	Meter, 100-0-100 micro-amp-TB (Model 100 only) - P&J	250-008 250-001
1	Bezel, meter	250-009
1	Terminal Post, Red	263-105
2	Terminal Post, Black	263-106
R33	Resistor, FC, 68Ω, 10%, 1/2W	201-680
4	Lamp, Decimal	400-114
2	Knob, Range & Null	214-010
6	Knob, KVD	214-011
1	Cover, Instrument (B only)	310-080
1	Handle, Instrument (B only)	285-004

REPLACEMENT PARTS LIST (Continued)

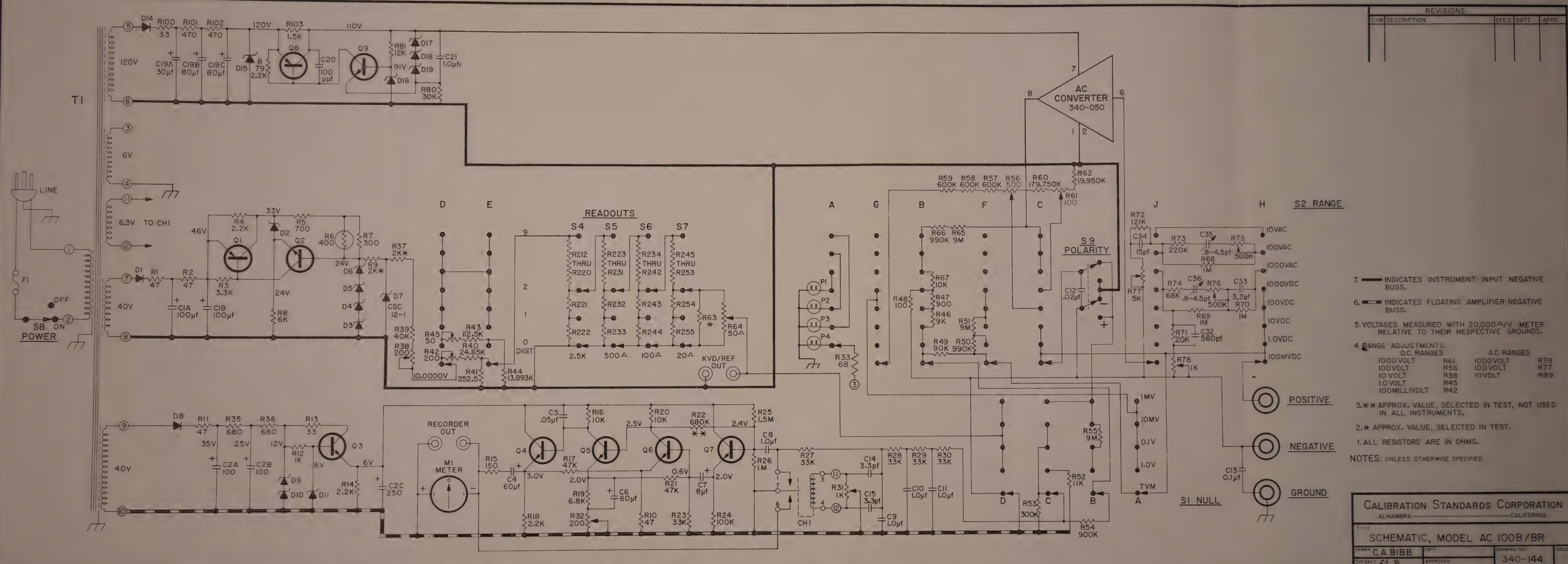
Reference or Quantity	Description	Stock Number
4	Feet, Rubber	283-003
1	Test Lead, Red	264-003
1	Test Lead, Black	264-002
C13	Capacitor, 0.1 mfd, 1000 vdc	220-040

NOTES

* (A) D7, the reference Zener diode, is carefully selected and stabilized by Calibration Standards Corporation. R9 is a precision wire wound resistor carefully selected to control the current through the reference diode, D7. R37 is a precision wire wound resistor, factory selected to drop the reference voltage from 13.5 ±5% vdc to 10.000 vdc. Failure of these components is extremely remote. It is recommended that the instrument be returned to the factory if a problem is suspected.

** (B) The resistors forming the Kelvin-Varley decks are factory matched to achieve an overall accuracy better than ±.005% absolute. When ordering, include instrument model and serial number.

*** (C) R64 is matched to the balance of the Kelvin-Varley divider by means of R63. R63 is factory selected and may vary in value from instrument to instrument.


REVISIONS
SYM DESCRIPTION EFF.S DATE APPD
T1
LINE
FI
OFF
S8 ON
POWER
6.3V TO CH1
AC CONVERTER 340-050
READOUTS
S4 S5 S6 S7
KVD/REF OUT
S9 POLARITY
S2 RANGE
10VAC
100VAC
1000VAC
1000VDC
100VDC
10VDC
1.0VDC
100MVDC
POSITIVE
NEGATIVE
GROUND
S1 NULL
1MV
10MV
0.1V
1.0V
TVM
RECORDER OUT
M1 METER
CH1
7. INDICATES INSTRUMENT INPUT NEGATIVE BUSS.
6. INDICATES FLOATING AMPLIFIER NEGATIVE BUSS.
5. VOLTAGES MEASURED WITH 20,000Ω/V METER RELATIVE TO THEIR RESPECTIVE GROUNDS.
4. RANGE ADJUSTMENTS:
D.C. RANGES
1000 VOLT R61
100 VOLT R56
10 VOLT R38
1.0 VOLT R45
100 MILLIVOLT R42
A.C. RANGES
1000 VOLT R78
100 VOLT R77
10 VOLT R99
3. ** APPROX. VALUE, SELECTED IN TEST, NOT USED IN ALL INSTRUMENTS.
2. * APPROX. VALUE, SELECTED IN TEST.
1. ALL RESISTORS ARE IN OHMS.
NOTES: UNLESS OTHERWISE SPECIFIED
CALIBRATION STANDARDS CORPORATION
ALHAMBRA CALIFORNIA
TITLE
SCHEMATIC, MODEL AC 100B/BR
DRAWN C.A. BIBB
DRAWING NO. 340-144
ISSUE

DWG. NO.	IS	SIZE
340-050		G

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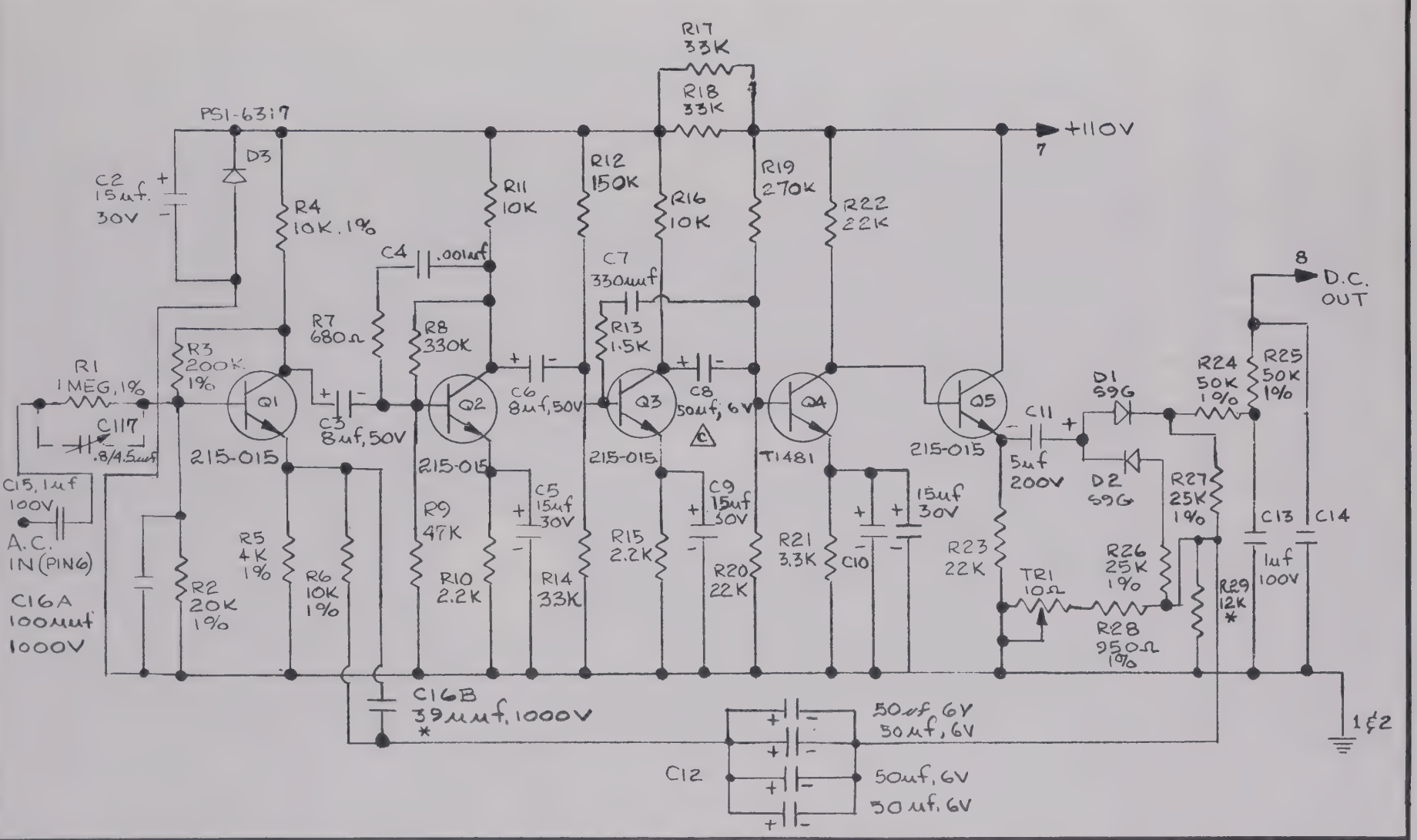
CHANGE	DATE	ISSUE	BY	APP.



DET.	MATERIAL	QTY.

TOLERANCES: EXCEPT AS SHOWN:	DATE:
FRACTION ±	DWN:
DECIMAL ±	CHKD:
ANGLES ±	APPD:
	SCALE:

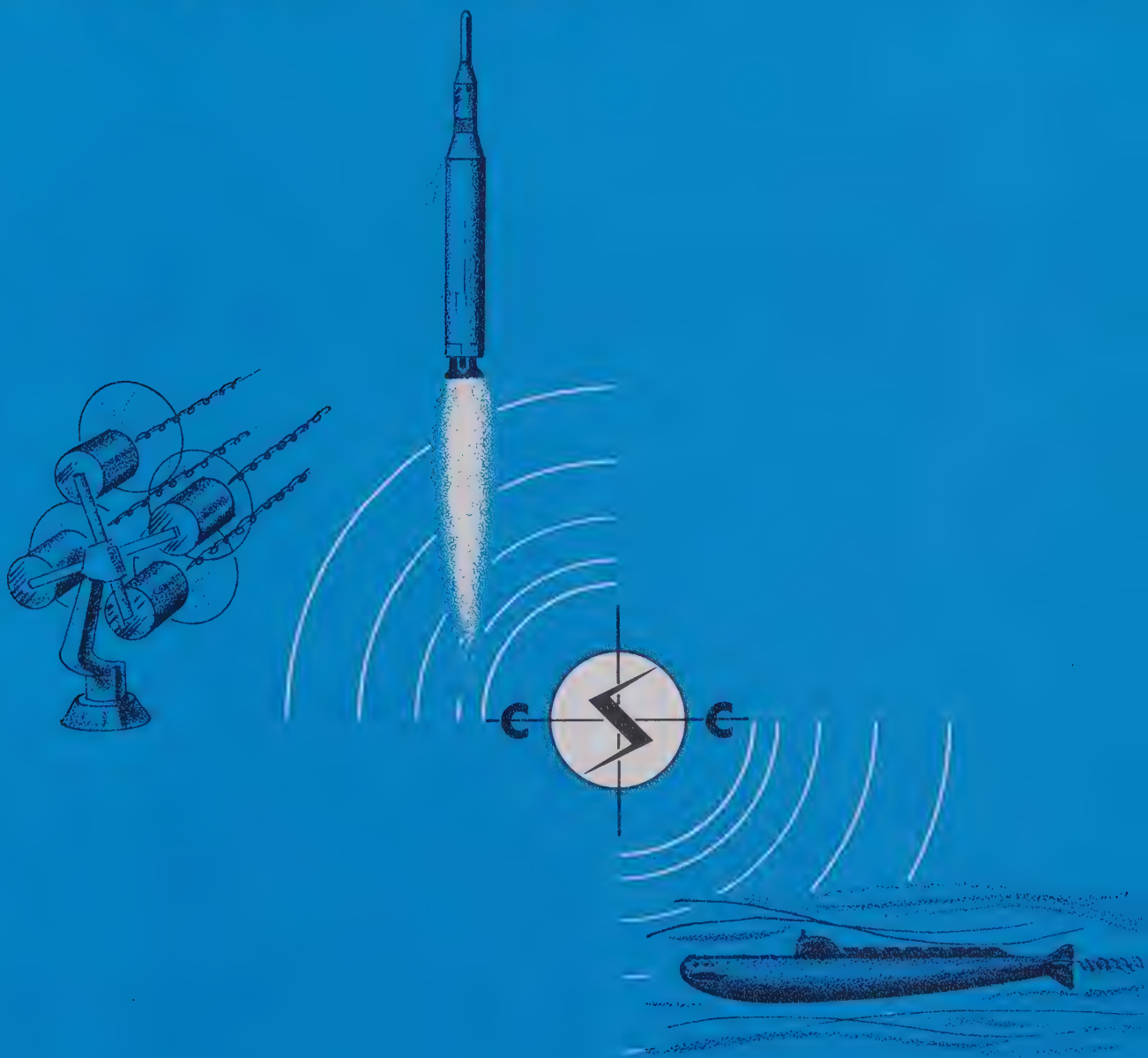
CALIBRATION STANDARDS CORPORATION
ALHAMBRA — CALIFORNIA

TITLE: CONVERTER AMPLIFIER

NEXT ASSEMBLY:
USED ON:

DRAWING NO. 340-050 ISSUE G

precision instruments



CALIBRATION STANDARDS CORPORATION

AC/DC CONVERTERS

Designed and engineered to extend the operation of existing DC Precision Voltmeters and DC Digital Voltmeters to have AC measuring capabilities, CSC's AC/DC CONVERTERS are used also in electronic systems where an AC signal must be converted to DC prior to control, computing or measuring.

Voltage Ranges: .5–10, 10–100, and 100–1000 VAC.

Frequency Range: 30 cps to 10 KC.

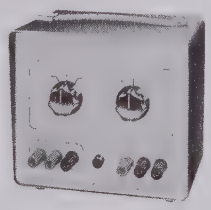
Voltage Accuracy: Model C-100A & AR: 0.15% absolute from .5 to 1000 VAC.

Input Impedance: 10 volt range—1 megohm and 20 micro-microfarads • 100 volt range—1 megohm and 20 micro-microfarads • 1000 volt range—2 megohms and 20 micro-microfarads.

Output: 0 to 10 volts DC into 10 megohms or infinite load.

Input Voltage: 115 volts AC, 50/60 cps.

Price: Model C-100A: $535.00.
Model C-100AR: $555.00.



C-100A

PRECISION VOLTAGE REFERENCE

The only completely solid-state Precision Voltage Reference accurate to ±0.005%, CSC's Model PVR-1A features a 6 digit dial out from any standard cell voltage from 1.01000 VDC to 1.02000 VDC.

Accuracy: ±0.005% at 25°C.

Output Impedance: 5000 ohms per volt.

Line Regulation: 0.001% (10 PPM) for 10% line voltage change.

Readout Linearity: 0.002% (20 PPM).

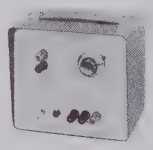
Stability: 0.002% (20 PPM) and 0.004% (40 PPM) per year typical for complete instrument.

Temperature Stability: 0.005% (5 PPM) per °C from +10°C to +40°C.

Input Voltage: 115 VAC, 50/60 cps—2 watts.

Output Terminals: Dual set—one providing 1.00000 VDC, the second providing adjustable voltage from 1.01000 to 1.02000 VDC.

Price: Model PVR-1A: $375.00.
Model PVR-1AR: $395.00.



PVR-1A

DC VOLT-AMP METER

The compact, potentiometric Precision DC Volt-Amp Meter, Model VA-100A, measures 0 to 1,000 volts DC with Accuracy of ±0.05% + 5 microvolts absolute and Current from 1 microampere to 1 ampere with Accuracy of ±0.1% and ±0.2% absolute. All Specifications same as DC-100A but include current measuring feature.

Current Accuracy:

0 to .1 ampere: ±0.1% of reading, 1/2 scale to full scale; ±0.2% of reading, 1/10 scale to 1/2 scale; 0.2% +0.001 microampere below 1 microampere.

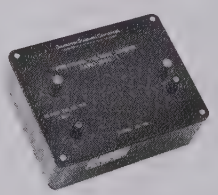
.1 to 1 ampere: ±0.2% of reading, 1/2 scale to full scale; ±0.3% of reading, 1/10 scale to 1/2 scale.

Price: Model VA-100A: $625.00.
Model VA-100AR: $645.00.

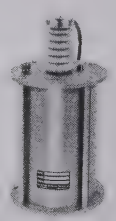
VA-100A

HIGH VOLTAGE DIVIDERS

	HV-10	HV-30
Range:	1000–10,000 VDC.	1000–30,000 VDC.
Ratio:	1000:1—10,000 volts input = 10 volts output.	30,000:9—30,000 volts input = 9 volts output.
Accuracy:	0.01% over a temperature range of 22.5°C to 27.5°C. 0.015% over a temperature range of 20°C to 30°C.	0.01% over a temperature range of 20°C to 30°C. Self-heating temperature must be taken into account.
Stability:	0.01%/year (ratio adjustable inside cabinet).	0.005%/year.
Input Resistance:	100 megohms.	60 megohms.
Size:	5¼" x 6¾" x 2 7/16"	5" diameter, 21" length including insulator.
Price:	$250.00.	$850.00.



HV-10A



HV-30

COMBINATION GALVANOMETER, POWER SUPPLY AND WHEATSTONE BRIDGES

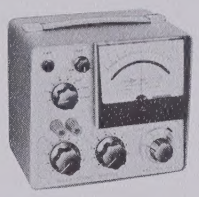
CSC's unique 3 in 1 combination with absolute accuracies to ±0.025 +0.003 ohm offers users an ultra-sensitive Wheatstone Bridge, all transistorized chopper readout amplifier and a bridge voltage power supply in a single, compact, lightweight and portable instrument for laboratory and production line test.

Accuracy: WB-110A and AR:
±0.025% + 0.003 ohm absolute.
WB-100A and AR:
±0.05% + 0.005 ohm absolute.

Range: 1 ohm to 100 megohms in 8 ranges.

Sensitivity: 1 mv for full scale. Chopper Amplifier. Variable front panel Bridge Voltage Control.

Price: WB-100A: $575.00.
WB-100AR: $595.00.
WB-110A: $685.00.
WB-110AR: $705.00.



WB-100A WB-110A

REGULATION MONITORS

Designed specifically to measure the stability of any DC voltage from 2.0 to 5,000 volts, CSC's three Regulation Monitors read out directly in percent deviation. Drift is less than 0.005% for an 8 hour day with short term drift less than 0.002%. At maximum sensitivity, the meter shows a full scale deflection for a deviation of ±0.1%.

Sensitivity: .1%, 1%, 10% full scale.

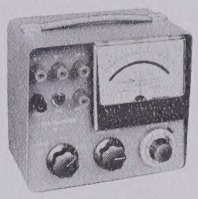
Voltage Range: RM-2A: 2–500 VDC.
RM-2A-3: 2–3000 VDC.
RM-2A-5: 2–5000 VDC.

Input Resistance: 7000 ohms per volt or greater.

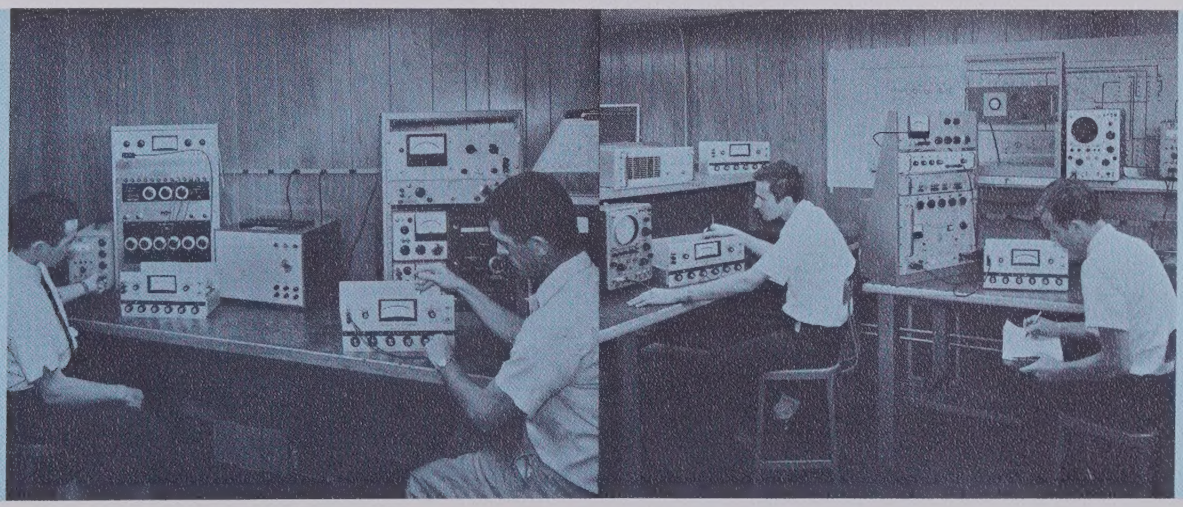
Stability: ±0.005% for a 10% line change.

Temperature Stability: ±0.005%/°C from 10–40°C.

Price: RM-2A: $390.00. RM-2AR: $410.00.
RM-2A-3: $485.00. RM-2AR-3: $505.00.
RM-2A-5: $595.00. RM-2AR-5: $615.00.



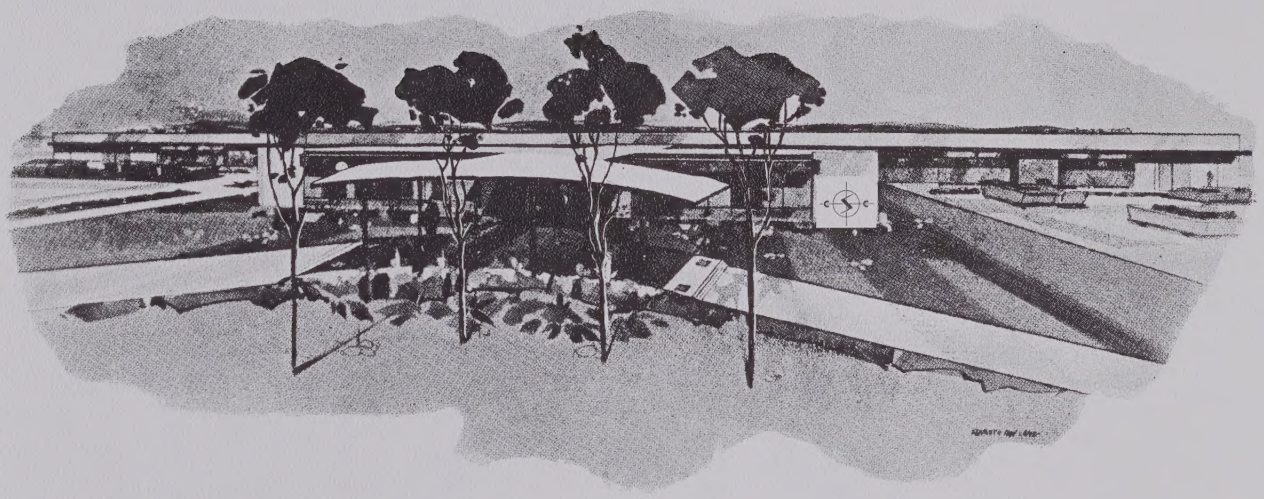
RM-2A



LABORATORY and PRODUCTION FACILITIES

CSC's laboratory and production facilities are among the most modern in the industry. To insure reliable operation of completed instruments, each component is thoroughly inspected and tested in Receiving. During each major step in production, CSC Precision Voltmeters and Power Supplies undergo rigid inspections and tests by Quality Assurance Specialists. This continuing program assures users of receiving quality instruments, ready for immediate application.

All instruments are calibrated in a temperature controlled area using calibration standards of 5 to 10 times more accuracy than the rated accuracy of the instrument being calibrated. All primary standards are traceable to the National Bureau of Standards. Certification of our instruments is available upon request at no charge. Each 150 series and 200 series instrument is tested in an environmental chamber over a temperature range of 10°C to 40°C to assure the customer of greatest accuracy over the total operating temperature range of the instrument. Calibration Standards Corporation has operated its voltmeters over a temperature range of −20°C to +100°C without impairing the operation of the instruments.



The architect's rendering depicts the new quarters for Calibration Standards Corporation, scheduled for completion in 1964. The new CSC home office will incorporate one of the most complete standards laboratories in industry and will provide CSC with almost double its present production, engineering, research and testing facilities. The new, air-conditioned facility will be located in the City of Industry.

REPRESENTED BY

CALIBRATION STANDARDS CORPORATION

A subsidiary of ROYAL INDUSTRIES, INC.
1031 Westminster Avenue
Alhambra, California